Available online at www.sciencedirect.com

ScienceDirect

Nurs Outlook 64 (2016) 137–145

Nursing Outlook

www.nursingoutlook.org

Identification and team-based interprofessional management of hospitalized vulnerable older adults

Jeff Edward Borenstein, MD, MPH[a], *Harriet Udin Aronow, PhD*[b,*], *Linda Burnes Bolton, DrPH, RN, FAAN*[b], *Mariane Ivy Dimalanta, MSN, RN-BC*[b], *Ellen Chan, LCSW*[c], *Katherine Palmer, PharmD*[d], *Xiao Zhang, PhD*[e], *Bradley Rosen, MD, MBA*[a], *Glenn David Braunstein, MD*[a]

[a] *Department of Medicine, Cedars-Sinai Medical Center, Los Angeles, CA*

[b] *Department of Nursing, Cedars-Sinai Medical Center, Los Angeles, CA*

[c] *Department of Case Management, Cedars-Sinai Medical Center, Los Angeles, CA*

[d] *Department of Pharmacy Services, Cedars-Sinai Medical Center, Los Angeles, CA*

[e] *Samuel Oschin Comprehensive Cancer Institute, Cedars-Sinai Medical Center, Los Angeles, CA*

ARTICLE INFO

Article history:
Received 14 May 2015
Revised 20 October 2015
Accepted 9 November 2015
Available online 22 November 2015

Keywords:
Older adult inpatients
Interprofessional team care
Comprehensive geriatric assessment
Cluster randomized trial
Program evaluation

ABSTRACT

Background: Extended hospital stays and complications are common among older adults and may lead to morbidity and loss of independence. Specialized geriatric units have been shown to improve outcomes but, with the growing numbers of older adults, may be difficult to scale to meet needs.

Purpose: The purpose was to evaluate a quality improvement initiative that redesigned unit-based workflow and trained interprofessional teams on general medical/surgical units to create care plans for vulnerable older adults using principles of comprehensive geriatric assessment and team management.

Method: The evaluation included a cluster randomized controlled trial of 10 medical/surgical units and intention-to-treat analysis of all patients meeting risk screening criteria.

Results: N = 1,384, median age = 80.9 years, and 53.5% female. Mean difference in observed vs. expected length of stay was 1.03 days shorter ($p = .006$); incidence of complications (odds ratio [OR] = 0.45; 95% confidence interval [CI] = 0.21–0.98) and transfer to intensive care (OR = 0.45; 95% CI = 0.25–0.79) lower among patients admitted to intervention units; incidence of discharge to institutional care was higher (OR = 1.43; 95% CI = 1.06–1.93). Mortality during hospitalization (OR = 0.64; 95% CI = 0.37–1.11) did not differ between groups.

Conclusion: Reorganizing general medical/surgical units to provide team-based interprofessional care can improve outcomes among hospitalized older adults.

Cite this article: Borenstein, J. E., Aronow, H. U., Bolton, L. B., Dimalanta, M. I., Chan, E., Palmer, K., Zhang, X., Rosen, B., & Braunstein, G. D. (2016, APRIL). Identification and team-based interprofessional management of hospitalized vulnerable older adults. Nursing Outlook, 64(2), 137-145. http://dx.doi.org/10.1016/j.outlook.2015.11.014.

Drs. J.E.B. and H.U.A. contributed equally to this work.

* *Corresponding author:* Harriet Udin Aronow, Cedars-Sinai Health System, Nursing Research, 8700 Beverly Blvd, Suite 021, Los Angeles, CA 90048.

E-mail address: harriet.aronow@cshs.org (H.U. Aronow).

http://dx.doi.org/10.1016/j.outlook.2015.11.014

Introduction

In 2012, there were 11.2 million acute hospital discharges among Medicare beneficiaries (Centers for Medicare & Medicaid Services, 2015). The Department of Health and Human Services (DHHS) estimates that one in four (27%) hospitalizations of Medicare patients results in harm, at a projected cost of $4.4 billion annually. Half of these occurrences of harm meet criteria for an adverse event, and an estimated 44% are potentially preventable (DHHS, 2010). The sheer magnitude of this problem argues that significant changes to organizational structure and processes of care might be necessary to better address the needs of older adult patients (Lafont et al., 2011).

One potential strategy for improving outcomes and lowering health care costs among older adults is the greater adoption of hospital-based applications of comprehensive geriatric assessment (CGA; Ellis, Whitehead, O'Neill, Langhorne, & Robinson, 2011). The World Health Organization describes CGA as a model of care that includes multidimensional health assessment, often conducted by multiple disciplines, coupled with recommendations for self-management and interprofessional care plans (Parker, 2005). CGA is often supported by evidence-based standardized geriatric assessment tools.

In one CGA model, acute care for elders (ACE) units (Flood, MacLennan, McGrew, Green, Dodd, & Brown, 2013), inpatient care for older adults is provided in specialized geriatric units staffed by interprofessional teams who are trained in CGA and the recognition and management of common geriatric syndromes, such as delirium, deconditioning/falls, depression, and social isolation. Systematic reviews suggest ACE units have the potential to reduce the incidence of a wide range of inpatient adverse events, shorten length of stay (LOS), lower hospitalization costs, and decrease the incidence of 30-day readmissions (Baztán, Suárez-García, López-Arrieta, Rodríguez-Mañas, & Rodríguez-Artalejo, 2009; Ellis et al., 2011; Fox et al., 2012). However, in the United States, individuals ages 65 years and older account for most (58.8%) of days spent in acute care, nonfederal facilities (Centers for Disease Control and Prevention, 2013). Creating sufficient numbers of ACE units to meet the current growth of the older patients presents a daunting challenge.

An alternative to dedicated ACE units is the use of mobile ACE (MACE) teams to provide expert geriatric care at any location within an inpatient facility. Although this approach offers the potential for flexibility and scalability, studies of the impact of MACE teams on cost and quality outcomes have not shown consistent benefit (Baztán, Suárez-García, López-Arrieta et al., 2009; Deschodt, Flamaing, Haentjens, Boonen, & Milisen, 2013; Edmans, Bradshaw, Franklin, Gladman, & Conroy, 2013; Hung, Ross, Farber, & Siu, 2013). An early meta-evaluation of CGA suggested that CGA interventions are most effective when care is followed closely by the CGA providers (Stuck, Siu, Wieland, Adams, & Rubenstein, 1993).

The conditions that have been found to be associated with successful CGA interventions, unit-based interprofessional teams and close follow up on recommendations, can be achieved by adapting the typical nursing unit workflow and, in essence, creating a protocol that identifies at-risk older adults and directs them to a unit-based CGA interprofessional care approach to hospital care. The interprofessional, team-based approach is increasingly recognized as an important strategy for improving health care delivery, in general (O'Leary et al., 2011; Walke & Tinetti 2013). The 2012 Institute of Medicine report "*Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*" (Smith, Cassell, Ferguson, Jones, & Redberg, 2012) emphasizes the importance of team-based collaborative care in creating adaptive systems to facilitate incorporation of advances in health care into routine practice. Team-based care is a consistent feature of ACE units shown to improve outcomes in randomized controlled studies (Barnes, Palmer, Kresevic, Fortinsky, Kowal, Chren, & Landefeld, 2012), and team-based care, not directed to older adults, has been successfully implemented on general inpatient medical units.

In this implementation study, we applied a variant model of CGA by introducing interprofessional CGA, triggered by risk screening and completed by the usual care team on nursing units. We sought to evaluate the impact of restructuring routine workflows on general medical inpatient units, training, and organizing existing personnel into interprofessional teams with standardized CGA tools and on-unit team meetings. Our main outcome measures were length of hospital stay and incidence of complications and transfers to ICU among at-risk older adult inpatients.

Methods

Quality Improvement Overview

This investigation represented the evaluation component of a quality improvement (QI) effort within a large, academic medical center. The hospital is one of the largest not-for-profit medical centers in the western United States with 886 licensed beds, a Level 1 Trauma Center, and several specialized quaternary care programs. The QI goal was to redesign usual delivery of hospital care on general medical/surgical nursing units to improve the efficiency of care while maintaining or improving the quality of outcomes for hospitalized vulnerable older adults in a manner that was both scalable and sustainable. As described previously (Aronow, Borenstein, Haus, Braunstein, & Bolton, 2014; Borenstein, Aronow, Bolton, Choi, Bresee, & Braunstein, 2013), an interprofessional leadership workgroup was formed to identify evidence-based best practices and gaps in current knowledge. A prior

prospective cohort analysis performed at our institution confirmed that a set of risk factors for adverse events during hospitalization could be identified within 24 hr of admission and therefore might be used trigger a prompt care plan of preventive recommendations feasible to implement during the hospital stay (Borenstein et al., 2013).

Two major QI efforts were undertaken in parallel. The hospital began a process to become designated as a Nurses Improving Care for Healthsystem Elders (NICHE) facility. NICHE is an international program to support the dissemination of evidence-based geriatric nursing practices and the delivery of age-sensitive care (Capezuti, Briccoli, & Boltz, 2013). Nurses throughout the hospital were encouraged to pursue education and certification in geriatric care through the NICHE on-line programs. The other parallel effort, overseen by the leadership workgroup, was the design of an interprofessional CGA tool and reengineering of daily care workflow to include early identification of patients at risk, CGA, and a daily interprofessional team huddle to discuss care plans for patients determined to be at risk for poor hospital outcomes.

Owing to resource constraints, not all medical nursing units could be brought onboard with the interprofessional CGA team assessment and on-unit daily meeting at the same time. This presented the opportunity to conduct a more rigorous evaluation of the CGA and daily interprofessional team huddle effort including cluster randomization of nursing units. Ten general medical inpatient units were randomly assigned either to implement the CGA and daily team huddle at that time (intervention units) or to continue usual care while waiting for resources to onboard the CGA and daily team huddle (comparison units). The only difference in standard care between the intervention and comparison units was the CGA workflow and engineering of the daily team huddle, as described below. Again, owing to resource constraints, the CGA and huddles were restricted to weekdays and included only those patients admitted between Sunday and Thursday.

The QI protocol was reviewed and approved by the institution's review board for the protection of human participants in research.

Participants

To identify at-risk older adult patients, nurses on the 10 units were trained on the use of the Fulmer "SPICES" criteria in their admission assessment. SPICES is a 6-item risk screening tool including identification of skin integrity, problems eating, incontinence, confusion, evidence of falls, and sleep disturbance (Fulmer, 2007). Those who met at least one of the SPICES criteria were deemed to be at greater risk for complications and extended stays during hospitalization.

All patients age 65 years and older admitted from the emergency department or directly from a doctor's office to one of the 10 units between July 28, 2012, and January 28, 2013, were screened for the presence of one or more SPICES criteria within 24 hr of admission. Patients transferred from other units (including intensive care) or other hospitals were excluded from this QI project. The assignment of patients to all 10 general medical inpatient units at our institution was performed by usual administrative procedures that were unchanged from those used before the intervention.

On comparison nursing units, a log was kept of newly admitted patients who were SPICES positive. Nurses were aware of the patients' SPICES status, but no other special QI projects were implemented, and patients received usual care.

Intervention Workflow

On the intervention units, e-mail notifications of newly admitted SPICES-positive patients, supported by an algorithm programmed into an electronic medical record (EMR), were sent to members of the unit's usual care team comprised direct care nurses, nurse manager and clinical nurse specialist, social worker, pharmacist, and a physician advisor who helped facilitate the team huddles. Teams received information limited only to the patients on their unit.

After notification that the patient screened at risk, team members were given 24 hr to complete a standardized comprehensive geriatric evaluation. Each discipline was provided tools and procedures to augment their routine assessments and the SPICES screening results to identify additional risk factors common to older hospitalized patients. Nurses collected additional information on cognition (Fong et al., 2011), identification of delirium and delirium risk (Inouye, 2006; Inouye, van Dyck, Alessi, Balkin, Siegal, & Horwitz, 1990; Maldonado, 2008; National Collaborating Centre for Acute and Chronic Conditions, 2010), and function (Katz, 1983). In addition, nurses used standard hospital screening checklists to determine when referrals for specialty care (e.g., physical therapy, occupational therapy, and nutrition services) might be appropriate. Pharmacists were trained in the Beers list of medications contraindicated and to be used with caution among older adults and reviewed records for the presence of medications that may be inappropriate for older persons (Fick et al, 2003; Woolcott et al, 2009). Social workers developed a list of key social and environmental factors and assessed the patient's support structures, social and functional trajectory, caregiver coping, recent hospitalizations, elements of advanced care planning, and the potential need for palliative care or end-of-life care.

To avoid duplication of effort and to share interprofessional assessment findings, a customized EMR note was created. The note automatically retrieved relevant routine clinical data from different locations in the medical record. The EMR note also provided space to input the additional data collected by the team into a standard format and to record team recommendations.

On the second day of admission, typically, the interprofessional unit-based care team met in a brief "huddle" to discuss the findings of their assessments. Positive findings were associated with evidence-based recommendations in drop-down menus on the EMR note; and each recommendation was discussed and accepted or rejected on the basis of team consensus. Physician advisors, who were part of the leadership workgroup, helped to facilitate discussions and offer suggestions but did not interview patients or their family members, examine patients, or write orders.

Team members each took responsibility for ensuring implementation of recommendations that could take place within their specialty scope of practice. For example, when appropriate, nurses incorporated the need for sleep hygiene to minimize delirium risk and passed the recommendation to the primary nurse in the next shift. Similarly, team pharmacists ensured that other pharmacy staff was aware of any age- or renal function–based medication dose adjustments that had been made. Often, but not exclusively, team social workers took responsibility for ensuring that issues such as the potential benefits of palliative care were raised to attending physicians, patients, and families.

Other recommendations requiring physician orders were communicated to the attending physicians responsible for managing the patients' diagnoses by whichever team member had been delegated with this task during the huddle. Central to these interactions was the recognition that the attending physician was the person responsible for the plan of care. All communication with attending physicians resulting from this QI initiative was intended to relate the interprofessional team's recommendations and the rationale behind them, to supplement and broaden the scope of care to include comorbid risk prevention not necessarily associated with the primary reason for hospital admission.

Measures

All the measures used in the evaluation analyses and reported in Tables 1–3 in this article were downloaded from administrative data routinely collected for each inpatient encounter at our institution and provided to the University HealthSystem Consortium (UHC) Clinical Data Base/Resource Manager™ (CDB/RM). The UHC is a nonprofit, member-driven, alliance of academic medical centers. The UHC data repository comprises a common set of demographic, diagnosis, procedural, admission source, discharge disposition, all-cause and related same hospital readmissions, resource utilization, and cost data from multiple academic institutions. Inpatient outcomes provided by the UHC CDB/RM include complications (diagnoses not present on admission), days in the intensive care unit (ICU), mortality during hospitalization, observed LOS, and destination on hospital discharge.

Expected LOS and relative expected mortality are calculated by UHC using validated logistic regression modeling to facilitate interinstitutional benchmarking and support individual member hospital quality of improvement efforts. Relative expected mortality calculation places each patient in a risk category that compares that patient's risk of mortality (estimated on severity factors) to the overall observed risk of mortality of other like patients (in the same base Medicare Diagnosis-Related Group [MSDRG] category). Admission severity is derived from 3M Health Information Systems, All Patient-Refined Diagnosis Related Groups (APR-DRGs), also provided by the UHC CDB/RM. The APR-DRGs are a commonly used tool for evaluating case mix, can explain up to 45% of the cost variance for different medical conditions (Quinn, 2014), and been shown to correlate with LOS (Pirson et al., 2013).

Hospital members may use their own UHC data for research and/or QI and, with permission, may publish

Table 1 – Admission Characteristics of the Intervention and Comparison Unit Patients

Characteristic	Intervention Unit Patients ($n = 792$)	Comparison Unit Patients ($n = 592$)	Statistical Test	p value*
Age (mean), in years	81.1	80.7	$T = 0.916$	0.360
Female	54.2%	52.7%	$\chi^2 = 0.292$	0.589
Race			$\chi^2 = 7.974$	0.047
Caucasian	76.0%	81.9%		
African American	17.8%	12.7%		
Asian American	3.9%	3.0%		
Other	2.3%	2.4%		
Insurance			$\chi^2 = 7.504$	0.058
Medicare +/or commercial	53.5%	57.3%		
Medicare and Medicaid	39.5%	34.1%		
Medicare alone	3.5%	5.7%		
Other/none	3.5%	2.9%		
Admission severity*			$\chi^2 = 1.197$	0.754
Minor	9.1%	8.1%		
Moderate	37.5%	35.6%		
Severe	43.3%	45.5%		
Extreme	10.1%	10.6%		

* Based on All Patient-Refined Diagnosis Related Groups.

Table 2 – Expected and Observed LOS of Intervention Unit and Comparison Unit Patients

Group Assignment	Expected LOS (SD)*	Observed LOS (SD)	Observed–Expected LOS (SD)
Intervention unit	5.62 (3.9)	5.40 (5.1)	−0.22 (4.5)
Comparison unit	5.80 (3.7)	6.60 (7.2)	0.80 (5.9)
Difference	−0.17	−1.20	−1.03

LOS, Length of Stay; SD, standard deviation.
* Values provided by the University Healthsystem Consortium.

results of analyses using UHC calculated variables. We used these severity-adjusted patient measures to best control for any underlying differences at admission between the patients admitted to intervention and comparison nursing units.

Statistical Analysis

All patients from the 10 nursing units who screened positive on SPICES during the 5 days per week that the program was active were included in the evaluation analyses of outcomes for intervention and comparison unit patients. This is referred to as an "intention-to-treat" design, where outcomes for patients on the intervention units are included whether they actually received CGA and interprofessional team huddle. A secondary analysis compared patients who were SPICES "positive" on the intervention and comparison units admitted during the evaluation period on days that the program was not active (weekends). This secondary analysis would help to determine if the "active ingredients" of the CGA and daily huddle were likely to account for any outcome differences found between the two clusters of units.

The main outcome of this investigation was the difference between observed and expected LOS. Using the difference between observed and expected LOS accounts for any underlying differences in admission severity among patients admitted to intervention and comparison nursing units. Other important outcomes included any complication during admission, any days in an ICU during admission, discharge to institutional care, discharge to home, discharge to hospice, and death during hospital.

Considering the cluster effect due to patients being grouped within involved hospital units, population-averaged method–generalized estimating equations were used to test the effect of the intervention for each outcome, while adjusting admission severity based on APR-DRG admission severity. Specifically, we assume that the primary outcome follows normal distribution and all the secondary outcomes follow binary distributions with the logistic link function.

Results

Baseline Characteristics

A total $N = 1{,}384$ patients were included in the intention-to-treat analyses. Table 1 describes the general admission characteristics of the patient population. A higher proportion of patients cared for in intervention units were African American (17.8% vs. 12.7%). No other significant differences between patient groups were observed. Of note, the average age was 80.9 years (standard deviation [SD] = 8.8 years; median = 82.0; range = 65–103), and approximately half (53.5%) of patients were female. Relative expected mortality, as calculated by UHC, was classified as "above" or "well above" the average of all hospitalized patients in the same MSDRG in 27.5% and 29.2% ($\chi^2 = 0.482$, $p = .488$) of patients admitted to intervention and comparison units, respectively.

Outcomes

LOS outcomes for intervention and comparison units are presented in Table 2. Comparison group patients had longer observed LOS than intervention group patients (6.60 days vs. 5.40 days). The observed LOS was shorter than expected (−0.22 days, SD = 4.5) for

Table 3 – Treatment Group Effects Adjusted by Hospital Units Clustered Within Treatment Group and Admission Severity

Outcome Measure	Actual Group Rates (%)		Adjusted Odds Ratio (95% Confidence Interval)	*p* value
	Intervention Units	Comparison Units		
Any complication during admission	1.8	3.7	0.45 (0.21–0.98)	0.043
Any days in ICU during admission	7.1	13.3	0.45 (0.25–0.79)	0.006
Death during hospital stay	3.2	4.7	0.69 (0.42–1.15)	0.160
Discharge to hospice	2.1	3.9	0.57 (0.30–1.08)	0.09
Discharge to home*	65.1	68.4	0.84 (0.64–1.11)	0.225
Discharge to institutional care	29.4	23.0	1.43 (1.06–1.93)	0.021
Readmission within 30 days†	16.0	15.3	0.99 (0.87–1.13)	0.906

ICU, intensive care unit.
Institutional care refers to acute rehabilitation, nursing home, or long-term care facility.
* With or without home health.
† Only accounts for readmissions to the same hospital from which patients were discharged.

intervention unit patients and longer than expected for comparison unit patients (0.80 days, SD = 5.9), a significant difference (−1.03 days, t test = 3.41; p = .001). The difference remained statistically significant with nonparametric testing (p = .005) and in adjusted linear regression analysis controlling for patients grouped within units clustered within treatment groups and admission severity (estimate = −1.01, 95% confidence interval = −1.73 to −0.30, Z = −2.77, p = .006).

The actual rates for all other outcomes and results of logistic regression analysis adjusted by units clustered within treatment group and admission severity are provided in Table 3. Readmission to our institution within 30 days of discharge, including readmission of the subset of patients discharged to institutional care (data not shown), did not differ significantly between the groups.

To further explore potential confounding due to underlying differences in intervention and comparison units that were unrelated to the QI program, we examined patient admission characteristics and outcomes during the evaluation period on days of the week in which the intervention was not active. On these "inactive" days, sociodemographic variables, severity of illness at admission, relative expected mortality were similar to days in which the intervention was active and did not differ among intervention and comparison units. Similarly, there were no statistically significant differences in either the primary outcome of observed-expected LOS (Figure 1) or any secondary outcomes on inactive days (data not shown).

Discussion

The findings of this evaluation support the redesign of inpatient care to emphasize a collaborative, team-based, and age-sensitive approach for the management of vulnerable older adults. Over the six months from program inception, the incidence of complications and transfers to intensive care for comparable patients were significantly lower in inpatient intervention units than in comparison units. At the same time, the difference in observed and expected LOS was one day shorter for patients in intervention units. This latter finding could be, at least in part, a consequence of the higher incidence of complications and transfers to ICU on the comparison units (Long, Brown, Ames, & Vincent, 2013; Zhan & Miller, 2003). No differences were found between the groups in either the incidence of 30-day readmissions overall or readmissions in the subset of patients discharged to subacute care settings. These results argue against the possibility of inappropriately shortened hospital stays among the intervention group units.

The higher rate of discharge to subacute care among patients receiving care in the intervention units has several possible explanations, including premature termination of inpatient care or care team recognition of continuing care needs. However, it is also possible that the slightly (nonsignificantly) higher rate of death and discharge to hospice among the comparison unit patients reduced the population most likely to require postdischarge subacute care. As the current investigation was not designed to evaluate factors associated with discharge destination, this question remains unanswered. In general, these results provide evidence that components of the ACE model found to be most effective in dedicated geriatric units can be integrated in standard processes of care on general medical inpatient units.

The success of established models of geriatric care, demonstrated in a wide range of health care settings, suggests that we have the requisite knowledge to improve health outcomes for older adults (Lakhan et al., 2011; Lee, Slack, Martin, Ehrman, & Chisholm-Burns, 2013; Mukamel et al., 2006). We sought to identify specific interventions associated with improved outcomes and to apply them in an efficient and reproducible manner, using existing hospital staff resources, without adding specialty care units. Older adults are at particularly high risk for complications during hospitalization and may suffer long-term sequelae, including significant functional impairment, loss of independence, and early mortality (Covinsky et al., 2003; Leape, 1991). However, there are many economic and logistical barriers to establishing sustainable models of integrated team-based care and programs targeted to specific geriatric risks (Institute of Medicine [IOM], 2008; SteelFisher, Martin, Dowal, & Inouye, 2013). We approached these challenges through education

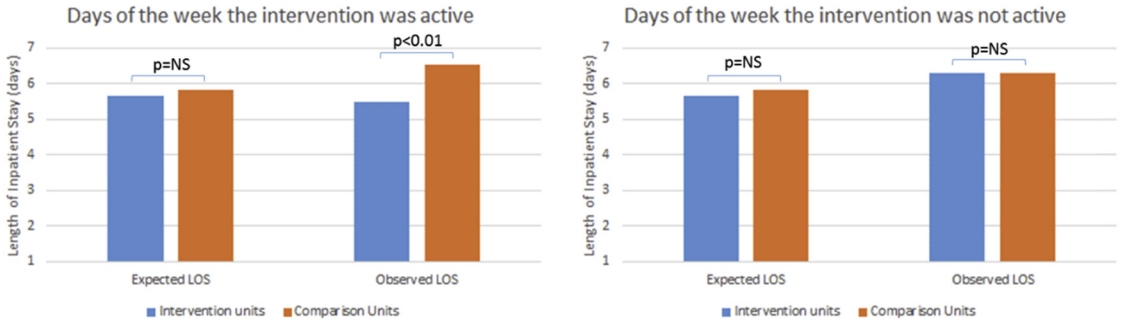

Figure 1 — Differences in the LOS outcome between intervention and comparison units on days of the week when intervention was active vs. days of the week when intervention was not active.

addressing key issues in geriatric care, redefining the roles and responsibilities of inpatient care team members, and incorporating standardized processes into the routine unit workflow.

In accordance with principles of system-supported practice (IOM, 2010), specific program elements were derived from a review of published literature, empirical data, and interprofessional consensus (Borenstein et al., 2013; Fox et al., 2013). Validated assessment tools were used to identify patient-specific risks and the presence of common geriatric syndromes. Team members had clear, well-defined roles and responsibilities, and relied on a tool integrated into an EMR-based note that accumulated and presented data from multiple sources. The note facilitated the exchange of information among team members during brief in-person huddles and documentation of clear and concise plans of care tailored to individual patient needs.

Since the completion of this evaluation, the CGA and interprofessional team huddle has been rolled out to all 10 medical/surgical nursing units. In the transition, pharmacy and social work departments have reallocated staff to be more unit-based and the physicians who helped to guide the implementation of team huddles were replaced by nurse-led huddles. Details of the preparation for the workflow changes, dose of intervention received, CGA outcomes, and most common recommendations formulated in the team huddles are planned for a companion article and are available on request from the authors.

Team huddles not only served to assist in the translation of interprofessional assessments into patient-specific care plans but also helped with identifying more global issues, such as unclear goals of therapy, the need for palliative care, and the potential appropriateness of hospice care. The resulting care plans were made available to all health care providers with access to the EMR, although specific assessment finding and recommendations were discussed directly with attending physicians.

Early recognition of increased risk for complications is essential for avoiding preventable morbidity and functional decline among hospitalized elderly (Mukamel et al, 2006). The development of reliable identification strategies for the acute care setting remains challenging (Wou et al., 2013). The SPICES criteria presented a strategy that could be readily employed by bedside nurses during intake assessment and was used in both intervention and comparison units. These criteria encompass domains associated with short-term mortality among hospitalized elders, including physical function, cognitive function, and nutrition (Thomas, Cooney, & Fried, 2013). Interprofessional team–based care may also help in prompt recognition of risk in this population (Cassel, 2004). The observation of fewer complications in the intervention group suggests the combination of a practical risk identification strategy and a team approach to integrating care may be more successful than an identification strategy (e.g., SPICES) alone.

Similarly, experience with the impact of EMRs on inpatient outcomes is mixed, particularly for adverse events during hospitalization (Buntin, Burke, Hoaglin, & Blumenthal, 2011; Dowding, Turley & Garrido, 2012; Furukawa, Raghu, & Shao, 2010). A report by one academic medical center suggests that EMRs may support the implementation of team-based care (O'Leary et al., 2011). Survey results suggest that in the United States at the present time, use of EMRs to address specific aspects of geriatric care is limited (Cumbler, Herman, & Pierce, 2012). We found EMR-based tools intended to facilitate the functioning of interprofessional teams and improve geriatric care to be invaluable, as initial efforts using a paper-based approach on a pilot unit at our institution were not successful.

This evaluation has limitations. The experience at one institution may be influenced by many factors and therefore not readily generalizable. As such, these findings are preliminary, and the QI process should be replicated at other institutions. For example, there was no control over the differential uptake of NICHE educational opportunities being offered and encouraged to all nurses in the institution; half of the nurses on intervention units completed the on-line training for geriatric nursing compared with only one quarter of the nurses on the comparison units.

Randomization of inpatient units into two five-unit clusters produced numerically different numbers of patients in the intervention and comparison groups. Selecting patients for intention-to-treat analyses based on common risk screening criteria and employing severity of illness on admission as a covariate in evaluating outcomes suggest that this imbalance did not result in selection bias effects in our analyses. A greater proportion of intervention unit patients were discharged to institutional settings, which raises the possibility that care was simply shifted from the acute to subacute setting. Though limited in that respect, the finding of similar readmission rates for patients discharged to skilled nursing facilities suggests that shorter stay and discharge to institutional settings did not result in increased risk of early acute hospital readmission. In performing this evaluation, we relied on the UHC database for estimates of baseline risk, inpatient and readmission outcomes, and risk adjustment. We note that other institutions have published studies in the peer-reviewed literature using the UHC database to assess inpatient outcomes (Graham et al., 2010; Khorana et al., 2008).

The observation of similar outcomes between intervention and comparison units on weekends, when team-based care was not in effect, provides further evidence against the presence of significant selection bias in patients from intervention and comparison units. Resource constraints that limited the intervention to weekdays also preclude making inferences about team-based care during weekends when staffing may be reduced. Inconsistencies of routine hospital care, such as the transfer of nurses and patients between intervention and comparison units, temporary

personnel, brief hospital stays, undoubtedly occurred, but would have biased to a null finding in the results of intention-to-treat analysis performed. Allowing these typical inconsistencies to occur was important to demonstrate generalizability and sustainability.

Conclusion

Reorganizing general medical units to provide team-based interprofessional care can improve outcomes among hospitalized older adults. Hospitals adopting this model of care should understand that the process of organizational change and organizational supports are complex, but essential, components accompanying the implementation of CGA principles and interprofessional team daily huddles to accommodate the needs of vulnerable older adults.

Acknowledgments

Drs. Borenstein and Aronow had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Role of funding sources: partial funding for this project was provided by The Eisner Foundation through an unrestricted grant to the Cedars-Sinai Medical Center. The funding agency had no role in the design, implementation, analysis, or interpretation of this project, nor any role in the preparation of the enclosed article. The authors wish to acknowledge the important contributions of the following individuals: (a) Rebecca Cohen, MPH, Department of Medicine; (b) Jane Swanson, PhD, RN; Flora Haus, MSN, RN; and Larry Santiago, EdD, RN; Department of Nursing; (c) Frank Saya, PharmD and Rita Shane, PharmD, Department of Pharmacy Services; (d) Sharon Mass, PhD, LCSW, Case Management and Social Work; and (e) Jonas Green, MD, MPH, MSHS, Cedars-Sinai Medical Care Foundation. The authors would also like to thank the many individuals within the Departments of Nursing, Pharmacy Services, Case Management and Social Work, General Internal Medicine, and Internal Service Providers who contributed to the successful implementation of this quality improvement initiative, and Lianna Klemp, MSN, RN for article review.

REFERENCES

Aronow, H. U., Borenstein, J., Haus, F., Braunstein, G. D., & Bolton, L. B. (2014). Validating SPICES as a screening tool for frailty risks among hospitalized older adults. *Nursing Research and Practice, 2014*, 846759.

Barnes, D. E., Palmer, R. M., Kresevic, D. M., Fortinsky, R. H., Kowal, J., Chren, M. M., & Landefeld, C. S. (2012). Acute care for elders units produced shorter hospital stays at lower cost while maintaining patients' functional status. *Health Affairs (millwood), 31*(6), 1227–1236.

Baztán, J. J., Suárez-García, F. M., López-Arrieta, J., Rodríguez-Mañas, L., & Rodríguez-Artalejo, F. (2009). Effectiveness of acute geriatric units on functional decline, living at home, and case fatality among older patients admitted to hospital for acute medical disorders: Meta-analysis. *BMJ, 338*, b50.

Borenstein, J., Aronow, H. U., Bolton, L. B., Choi, C., Bresee, C., & Braunstein, G. D. (2013). Early recognition of risk factors for adverse outcomes during hospitalization among Medicare patients: A prospective cohort study. *BMC Geriatrics, 13*, 72.

Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: A review of the recent literature shows predominantly positive results. *Health Affairs, 30*(3), 464–471.

Capezuti, E., Briccoli, B., & Boltz, M. (2013). Nurses Improving the Care of Healthsystem Elders: Creating a sustainable business model to improve care of hospitalized older adults. *Journal of the American Geriatric Society, 61*(8), 1387–1393.

Cassel, C. K. (2004). Geriatrics: A vital core of hospital medicine. In *Caring for the hospitalized elderly: Current best practice and new horizons, The Hospitalist. (Special supplement)* (pp. 2–3).

Centers for Disease Control & Prevention. *National Center for Health Statistics/Office of Analysis and Epidemiology*, 2013. Retrieved from http://www.cdc.gov/nchs/hus/contents2012.htm#094

Centers for Medicare & Medicaid Services. (2015). *Office of Information Products and Data Analytics. Statistics; Table IV.1.* Retrieved from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/CMS-Statistics-Reference-Booklet/index.html

Covinsky, K. E., Palmer, R. M., Fortinsky, R. H., Counsell, S. R., Stewart, A. L., Kresevic, D., & Landefeld, C. S. (2003). Loss of independence in activities of daily living in older adults hospitalized with medical illnesses: Increased vulnerability with age. *Journal of the American Geriatric Society, 51*(4), 451–458.

Cumbler, E. U., Herman, C., & Pierce, J. R. (2012). The electronic health record and improving quality for hospitalized elderly adults. *Journal of the American Geriatric Society, 60*(11), 2177–2178.

Deschodt, M., Flamaing, J., Haentjens, P., Boonen, S., & Milisen, K. (2013). Impact of geriatric consultation teams on clinical outcome in acute hospitals: A systematic review and meta-analysis. *BMC Medicine, 11*, 48.

Department of Health and Human Services (DHHS), Office of Inspector General. (2010). *Adverse events in hospitals: National incidence among Medicare beneficiaries.* Washington (DC): HHS. Retrieved from http://oig.hhs.gov/oei/reports/oei-06-09-00090.pdf.

Dowding, D. W., Turley, M., & Garrido, T. (2012). The impact of an electronic health record on nurse sensitive patient outcomes: An interrupted time series analysis. *Journal of the American Medical Informatics Association, 19*, 615–620.

Edmans, J., Bradshaw, L., Franklin, M., Gladman, J., & Conroy, S. (2013). Specialist geriatric medical assessment for patients discharged from hospital acute assessment units: Randomised controlled trial. *British Medical Journal, 347*, f5874.

Ellis, G., Whitehead, M. A., O'Neill, D., Langhorne, P., & Robinson, D. (2011). Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database of Systematic Reviews*, (7), CD006211.

Fick, D. M., Cooper, J. W., Wade, W. E., Waller, J. L., Maclean, J. R., & Beers, M. H. (2003). Updating the Beers criteria for potentially inappropriate medication use in older adults: Results of a US consensus panel of experts. *Archives of Internal Medicine, 163*(22), 2716–2724.

Flood, K. L., MacLennan, P. A., McGrew, D., Green, D., Dodd, C., & Brown, C. J. (2013). Effects of an acute care for elders unit on

costs and 30-day readmissions. *JAMA Internal Medicine, 173*(11), 981–987.
Fong, T. G., Jones, R. N., Rudolph, J. L., Yang, F. M., Tommet, D., Habtemarian, D., & Inouye, S. K. (2011). Development and validation of a brief cognitive assessment tool: The sweet 16. *Archives Internal Medicine, 171*(5), 432–437.
Fox, M. T., Persaud, M., Maimets, I., O'Brien, K., Brooks, D., Trequnno, D., & Schraa, E. (2012). Effectiveness of acute geriatric unit care using acute care for elders components: A systematic review and meta-analysis. *Journal of the American Geriatric Society, 60*(12), 2237–2245.
Fox, M. T., Sidani, S., Persaud, M., Trequnno, D., Maimets, I., Brooks, D., & O'Brien, K. (2013). Acute care for elders components of acute geriatric unit care: Systematic descriptive review. *Journal of the American Geriatrics Society, 61*(6), 939–946.
Fulmer, T. (2007). How to try this. Fulmer SPICES: A framework of six 'marker conditions' can help focus assessment of hospitalized older patients. *American Journal of Nursing, 107*(10), 40–49.
Furukawa, M. F., Raghu, T. S., & Shao, B. B. M. (2010). Electronic medical records, nurse staffing, and nurse-sensitive patient outcomes: Evidence from California hospitals, 1998–2007. *Health Services Research, 45*(4), 941–962.
Graham, B. B., Keniston, A., Gajic, O., Trillo, A. C. A., Medvedev, S., & Douglas, I. S. (2010). Diabetes mellitus does not adversely affect outcomes from a critical illness diabetes mellitus does not adversely affect outcomes from a critical illness. *Critical Care Medicine, 38*(1), 16–24.
Hung, W. W., Ross, J. S., Farber, J., & Siu, A. L. (2013). Evaluation of the Mobile Acute Care of the Elderly (MACE) service. *JAMA Internal Medicine, 173*(11), 990–996.
Inouye, S. K. (2006). Delirium in older persons. *New England Journal of Medicine, 354*(11), 1157–1165.
Inouye, S. K., van Dyck, C. H., Alessi, C. A., Balkin, S., Siegal, A. P., & Horwitz, R. I. (1990). Clarifying confusion: The confusion assessment method. A new method for detection of delirium. *Annals of Internal Medicine, 113*(12), 941–948.
Institute of Medicine (IOM). (2008). *Evidence-based Medicine and the changing nature of healthcare: 2007 IOM annual meeting summary*, (US). Washington (DC): National Academies Press (US).
Institute of Medicine (IOM). (2010). The healthcare imperative: Lowering costs and improving outcomes: Workshop series summary. In P. L. Yong, R. S. Saunders, & L. A. Olsen (Eds.), *Institute of Medicine (US) roundtable on evidence-based medicine*. Washington (DC): National Academies Press (US).
Katz, S. (1983). Assessing self-maintenance—activities of daily living, mobility, and instrumental activities of daily living. *Journal of the American Geriatrics Society, 31*(12), 721–727.
Khorana, A. A., Francis, C. W., Blumberg, N., Culakova, E., Refaai, M. A., & Lyman, G. H. (2008). Blood transfusions thrombosis and mortality in hospitalized patients with cancer. *Archives of Internal Medicine, 168*(21), 2377–2381.
Lafont, C., Gérard, S., Voisin, T., Pahor, M., Vellas, B., & Members of I.A.G.G./A.M.P.A Task Force. (2011). Reducing "iatrogenic disability" in the hospitalized frail elderly. *Journal of Nutrition Health and Aging, 15*(8), 645–660.
Lakhan, P., Jones, M., Wilson, A., Courtney, M., Hirdes, J., & Gray, L. C. (2011). A prospective cohort study of geriatric syndromes among older medical patients admitted to acute care hospitals. *Journal of the American Geriatrics Society, 59*(11), 2001–2008.
Leape, L. L., Brennan, T. A., Laird, N., Lawthers, A. G., Localio, A. R., Barnes, B. A., & Hiatt, H. (1991). The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *New England Journal of Medicine, 324*(6), 377–384.
Lee, J. K., Slack, M. K., Martin, J., Ehrman, C., & Chisholm-Burns, M. (2013). Geriatric patient care by U.S. pharmacists in healthcare teams: Systematic review and meta-analyses. *Journal of the American Geriatrics Society, 61*, 1119–1127.
Long, S. J., Brown, K. F., Ames, D., & Vincent, C. (2013). What is known about adverse events in older medical hospital inpatients? A systematic review of the literature. *International Journal of Quality in Health Care, 25*(5), 542–554.
Maldonado, J. R. (2008). Delirium in the acute care setting: Characteristics, diagnosis and treatment. *Critical Care Clinics, 24*(4), 657–722.
Mukamel, D. B., Temkin-Greener, H., Delavan, R., Peterson, D. R., Gross, D., Kunitz, S., & Williams, T. F. (2006). Team performance and risk-adjusted health outcomes in the Program of All-Inclusive Care for the Elderly (PACE). *Gerontologist, 46*(2), 227–237.
National Collaborating Centre for Acute and Chronic Conditions. (2010). *Delirium: Diagnosis, prevention and management (Clinical guideline; no. 103)*. London (UK): National Institute for Health and Clinical Excellence (NICE).
O'Leary, K. J., Buck, R., Fligiel, H. M., Haviley, C., Slade, M. E., Landler, M. P., & Wayne, D. B. (2011). Structured interdisciplinary rounds in a medical teaching unit: Improving patient safety. *Archives of Internal Medicine, 171*(7), 678–684.
Parker, S. G. (2005). *Do current discharge arrangements from inpatient hospital care for the elderly reduce readmission rates, the length of inpatient stay or mortality, or improve health status?* Copenhagen: WHO Regional Office for Europe. Health Evidence Network report. Retrieved from http://www.euro.who.int/Document/E87542.pdf.
Pirson, M., Delo, C., Di Pierdomenico, L., Laport, N., Biloque, V., & Leclercq, P. (2013). Variability of nursing care by APR-DRG and by severity of illness in a sample of nine Belgian hospitals. *BMC Nursing, 12*(1), 26.
Quinn, K. (2014). After the revolution: DRGs at age 30. *Annals of Internal Medicine, 160*(6), 426–429.
Smith, M., Cassell, G., Ferguson, B., Jones, C., & Redberg, R. (2012). *Best care at lower cost: The path to continuously learning health care in America*. Retrieved from http://www.iom.edu/Reports/2012/Best-Care-at-Lower-Cost-The-Path-to-Continuously-Learning-Health-Care-in-America.aspx.
SteelFisher, G. K., Martin, L. A., Dowal, S. L., & Inouye, S. K. (2013). Learning from the closure of clinical programs: A case series from the Hospital Elder Life Program. *Journal of the American Geriatrics Society, 61*(6), 999–1004.
Stuck, A. E., Siu, A. L., Wieland, G. D., Adams, J., & Rubenstein, L. Z. (1993). Comprehensive geriatric assessment: A meta-analysis of controlled trials. *Lancet, 342*(8878), 1032–1036.
Thomas, J. M., Cooney, L. M., & Fried, T. R. (2013). Systematic review: Health-related characteristics of elderly hospitalized adults and nursing home residents associated with short-term mortality. *Journal of the American Geriatricsics Society, 61*, 902–911.
Walke, L. M., & Tinetti, M. E. (2013). ACE, MACE, and GRACE: Time to put the pieces together. *JAMA Internal Medicine, 173*(11), 987–989.
Woolcott, J. C., Richardson, K. J., Wiens, M. O., Patel, B., Marin, J., Khan, K. M., & Marra, C. A. (2009). Meta-analysis of the impact of 9 medication classes on falls in elderly persons. *Archives of Internal Medicine, 169*(21), 1952–1960.
Wou, F., Gladman, J. R., Bradshaw, L., Franklin, M., Edmans, J., & Conroy, S. P. (2013). The predictive properties of frailty-rating scales in the acute medical unit. *Age and Ageing, 42*(6), 776–781.
Zhan, C., & Miller, M. R. (2003). Excess length of stay, charges, and mortality attributable to medical injuries during hospitalization. *JAMA, 290*(14), 1868–1874.